PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :
B26D 1/40, 1/62, 3/08
B31B 1/14, 1/25

A1

(11) International Publication Number: **WO 92/08584**

(43) International Publication Date: 29 May 1992 (29.05.92)

(21) International Application Number: PCT/US91/04297

(22) International Filing Date: 18 June 1991 (18.06.91)

(30) Priority data:
611,075 9 November 1990 (09.11.90) US

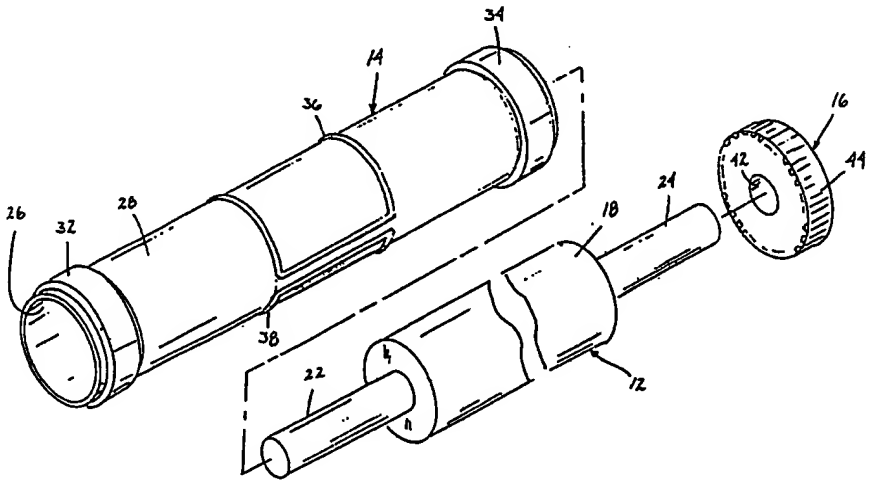
(71)(72) Applicant and Inventor: ROSEMANN, Richard, R. [US/US]; 456 South Clay, Kirkwood, MO 63122 (US).

(74) Agents: ROLNICKI, Joseph, M. et al.; Rogers, Howell & Haferkamp, 7777 Bonhomme, Suite 1700, St. Louis, MO 63105 (US).

(81) Designated States: AT (European patent), AU, BE (European patent), BR, CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FI, FR (European patent), GB (European patent), GR (European patent), HU, IT (European patent), JP, KR, LU (European patent), NL (European patent), SE (European patent).

Published
With international search report.

(54) Title: ROTARY CUTTING DIE ASSEMBLY



(57) Abstract

A rotary cutting die assembly (10) comprised of a mandrel (12) adapted to be rotatably mounted in a rotary die cutting press, and a cylindrical cutting sleeve (14) and drive gear (16) slip fit over the mandrel (12), provide a method and apparatus for replacing the cutting edge (36, 38) of a rotary cutting die (10) at a reduced cost for materials, manufacturing and shipping than that associated with conventional rotary cutting die replacement.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	ES	Spain	MG	Madagascar
AU	Australia	FI	Finland	ML	Mali
BB	Barbados	FR	France	MN	Mongolia
BE	Belgium	GA	Gabon	MR	Mauritania
BF	Burkina Faso	GB	United Kingdom	MW	Malawi
BG	Bulgaria	GN	Guinea	NL	Netherlands
BJ	Benin	GR	Greece	NO	Norway
BR	Brazil	HU	Hungary	PL	Poland
CA	Canada	IT	Italy	RO	Romania
CF	Central African Republic	JP	Japan	SD	Sudan
CG	Congo	KP	Democratic People's Republic of Korea	SE	Sweden
CH	Switzerland			SN	Senegal
CI	Côte d'Ivoire	KR	Republic of Korea	SU+	Soviet Union
CM	Cameroon	LI	Liechtenstein	TD	Chad
CS	Czechoslovakia	LK	Sri Lanka	TG	Togo
DE*	Germany	LU	Luxembourg	US	United States of America
DK	Denmark	MC	Monaco		

+ Any designation of "SU" has effect in the Russian Federation. It is not yet known whether any such designation has effect in other States of the former Soviet Union.

ROTARY CUTTING DIE ASSEMBLY

Background of the Invention

(1) Field of the Invention

The present invention relates to a rotary cutting die assembly that is comprised of separable component parts. In particular, the invention pertains to a rotary cutting die assembly comprised of a mandrel having a cutting cylinder and drive gear slip fit thereon. The cutting cylinder performs the cutting operations of the assembly and is replaceable when worn. The rotary cutting die assembly of the present invention enables reductions in material costs, heat treatment costs, and shipping costs from those costs associated with manufacturing and distributing conventional rotary cutting dies.

(2) Description of the Related Art

Prior art rotary cutting die presses commonly employ a rotating cutting die and a rotating anvil roll mounted parallel to the cutting die on the press. The cutting die and anvil roll rotate against each other as stock material or a web of stock is passed through the press between the rotating die and anvil. A pressure

assist roll or a load carrying truck or tractor assembly is often employed to exert a downward force on the die and cause it to bear against the anvil roll. As the material passes between the rotating die and anvil, a cutting configuration formed on the exterior surface of the cutting die cuts sections of material from the web. The shape of the sections of material cut from the web correspond to the configuration of the cutting edges of the die.

Self adhesive labels or pressure sensitive labels and other similar articles are commonly provided in rolls of such labels. The rolls are made up of a plurality of self stick labels attached to a continuous length of backing material. The self stick labels are readily removed from the rolls of backing material by merely peeling the labels from the material.

Rotary production of pressure sensitive labels is accomplished by passing a web of pressure sensitive label stock comprising the label material, a layer of pressure sensitive adhesive, and a backing layer to which the adhesive holds the label material, between a rotary cutting die and a smooth anvil roll rotatably mounted on a die cutting press. As set forth above, the cutting die has an exterior cylindrical surface with cutting edge configurations formed thereon. The configuration of the die cutting edges is determined in accordance with the shapes desired of the labels to be cut from the label stock. As the label stock is passed between the cutting die and the anvil roll of the press, labels are produced by crush cutting through the label material and the layer of pressure sensitive adhesive, to the backing layer of the stock. The cutting die does not cut through the backing layer and the above described operation forms a continuous sheet of self adhesive labels that may be removed from the backing.

Rotary cutting dies of the type used in preparing label strips are commonly formed from a solid steel cylinder. The cylinder is large enough in diameter to provide a peripheral surface area sufficient in size to accommodate several cutting edge configurations required for a desired label shape or set of label shapes to be cut from label stock. The diameter of the cylinder is also chosen to provide sufficient strength to the cylinder to prevent any deflection of the cylinder during rotary cutting operations of the press.

The cutting edge configurations are typically engraved on the exterior surface of the rotary cutting die by various methods such as mechanical milling, chemical milling or spark erosion. The dies are also formed with journal shafts protruding from their opposite ends. The journal shafts are used in mounting a gear on the rotary cutting die, and for rotatably mounting the die in a rotary die cutting press. The gear mounted on the die meshes with a gear on the anvil roll of the press to deliver a rotational force to the rotary cutting die and to maintain the rotary cutting die, the anvil roll, and other operations performed by the rotary cutting press in synchronism.

The opposite ends of the cutting die, just inside of the journal shafts, are formed with a cylindrical bearing surface having a diameter that is equal to or slightly greater than the diameter of the peripheral surfaces of the cutting edges. These opposite surfaces of the die form bearing rolls. The bearing rolls maintain constant the distance of the anvil roll axis from the cutting die axis for proper mesh of the cutting die gear and the anvil gear of the press and for controlling the distance of the die's cutting edges from the anvil roll.

A variation of the above described prior art cutting die provides an undercut magnetic area between

the bearing rolls of the cutting die. The area is undercut to accept a flexible steel sheet having the desired cutting edge configurations engraved thereon.

Rotary cutting dies of the type described above are disadvantaged in that they are expensive to manufacture, and correspondingly expensive to replace when worn. Because the diameter of a rotary cutting die must be made large enough to both prevent center deflection of the die during a cutting operation and to provide adequate surface area for the plurality of cutting edge configurations desired on the die, a significant materials cost is involved in the manufacture of a rotary cutting die. Because the cost of heat treating a die is based on the weight of the die, the more material used in manufacturing the die correspondingly increases the costs involved in heat treating the die. Moreover, because shipping costs are directly related to the weight of the product being shipped, the costs involved in delivering the cutting dies to purchasers is also directly related to the weight of materials involved in manufacturing the die.

Accordingly, it would be advantageous to provide a method of making a rotary cutting die as an assembly of component parts, where one component part of the assembly comprising the cutting edge configurations is separable from the remainder of the assembly after a period of wear, and is replaceable by a new component part. Such an assembly would reduce the materials cost involved in manufacturing an entire rotary cutting die to replace a die whose cutting edges have worn. Such an assembly would also reduce the heat treatment costs, which are based on weight, involved in manufacturing a replacement rotary cutting die in that only the component part being replaced need be heat treated.

Such an assembly would also reduce the shipping costs involved in replacing a worn rotary cutting die in

that only the component part replacing the worn component part need be shipped.

The present invention overcomes the problems associated with conventional rotary cutting dies by providing a rotary cutting die assembly comprised of several component parts, with each component part being separable from the assembly and replaceable, thereby reducing the costs of material, heat treatment, and shipping associated with replacing an entire worn rotary cutting die of the prior art.

Summary of the Invention

The rotary cutting die assembly of the present invention is generally comprised of three component parts. The cutting die includes a mandrel, a cutting sleeve, and a drive gear. The component parts of the cutting die assembly are adapted to be assembled on a rotary cutting die press of the type employing an anvil roll, against which the rotary cutting die assembly of the present invention bears.

The mandrel is generally a cylinder of solid material. A center portion of the mandrel cylinder has a constant diameter across its entire axial length. Left and right side journal shafts project outward from opposite ends of the center portion of the mandrel. The journal shafts are cylindrical and also have substantially constant diameters along their entire axial lengths. The diameters of the journal shafts are reduced from the diameter of the mandrel center portion and are dimensioned to be rotatably received in bearings of the rotary cutting die press.

The cutting edge configurations of the die assembly of the present invention are formed on an exterior surface of the cylindrical cutting sleeve of the present invention. The sleeve itself is formed as a hollow cylinder and has a substantially constant inner diameter across its axial length. The sleeve also has a substan-

tially constant outer diameter across its axial length, except for the raised edges of the cutting configurations formed on the exterior surface of the sleeve and a pair of cylindrical bearing rolls formed on opposite ends of the sleeve. The configuration of the die sleeve cutting edges is determined according to the shapes desired of the labels to be cut from label stock by the die assembly.

The diameter of the peripheral surface of the bearing rolls is equal to or slightly greater than the diameter of the peripheral surface of the cutting edges formed on the cutting sleeve. The bearing rolls maintain a constant distance between the axis of the assembly cutting sleeve and the axis of the press anvil roll, and maintain constant the distance between the cutting edge configurations of the sleeve and the exterior surface of the anvil roll.

The interior diameter of the cutting sleeve is dimensioned to enable the sleeve to be slip fit over the center portion of the mandrel. The thickness of the sleeve wall is chosen to enable the sleeve to deform slightly when the assembly of the invention is employed in a cutting press of the type having an anvil roll opposed by a pressure assist roll or a load carrying truck or tractor assembly, and the sleeve is compressed between the anvil roll and the pressure assist roll or load carrying truck or tractor assembly.

The drive gear of the assembly is provided with a center bore dimensioned to enable the gear to be slidably received over an end journal shaft of the mandrel. The drive gear positively engages with the cylindrical cutting sleeve mounted on the mandrel center portion, and meshes with a gear on the anvil roll of the printing press on which the cutting die assembly is mounted. The drive gear delivers a rotational force to the rotary cutting die assembly and maintains the rotary cutting

assembly, the anvil roll, and other operations performed by the rotary cutting press in synchronism.

The rotating cutting die assembly of the present invention is unique in that the cutting edge configurations and bearing rolls of the assembly are machined onto a thin walled cylindrical sleeve that is slip fit on the mandrel. The cutting edges formed on the cylindrical cutting sleeve are subject to wear during use of the invention in cutting operations. A cutting sleeve with worn edges is removable from the mandrel and replaceable by a new sleeve. The cutting sleeves represent a small percentage of the total weight of the rotary cutting die assembly, and the material costs, heat treatment costs, and shipping costs involved in the manufacture and replacement of the cutting cylinder sleeve are significantly less than those involved in replacing an entire rotary cutting die of the prior art.

Brief Description of the Drawings

Further objects and features of the present invention are revealed in the following detailed description of the preferred embodiment of the invention and in the drawings figures wherein:

Figure 1 is an assembled view, partially in section, of the rotary cutting die assembly of the present invention;

Figure 2 is an exploded perspective view of the separate component parts that make up the rotary cutting die assembly of the present invention; and

Figure 3 is an end elevation view of the rotary cutting die assembly of the present invention taken along the line 3-3 of Figure 1 and showing the assembly in operation between an anvil roll and a pressure assist roll of a die cutting press.

Description of the Preferred Embodiment

Figure 1 shows the rotary cutting die assembly 10 of the present invention. The assembly is generally comprised of a mandrel 12, a cylindrical cutting sleeve 14, and a drive gear 16.

The mandrel 12 is constructed with three separate sections. A middle section or portion 18 of the mandrel has a cylindrical exterior surface. The diameter of the middle section 18 is substantially constant across the entire axial length of the section. Left and right journal shaft sections or portions 22, 24 extend axially from opposite ends of the mandrel middle section 18. The journal shaft sections are concentric with the mandrel middle section. The left and right journal shafts 22, 24 also have substantially constant diameters along their axial length. The shaft diameters are both equal and are reduced from the diameter of the mandrel middle section 18. The diameter dimensions of the left and right journal shafts 22, 24 are determined to enable the shafts to be rotatably mounted on a conventional die cutting press, thereby rotatably mounting the mandrel 12 on the press.

The cylindrical cutting sleeve 14 has a hollow cylindrical bore through its entire axial length, providing the sleeve with an interior surface 26 and an exterior surface 28. The sleeve interior surface 26 has a substantially constant diameter across the entire axial length of the sleeve. The dimensions of the interior diameter of the sleeve are determined to enable the sleeve 14 to be removably slip fit over the exterior surface of the mandrel middle section 18.

The exterior surface 28 of the cutting sleeve 14 is also cylindrical. The sleeve exterior has a substantially constant diameter across the entire axial length of the sleeve, except for a pair of bearer rolls 32, 34 formed at opposite ends of the sleeve and the cutting edge configurations 36, 38 formed on the sleeve surface.

The cutting edge configurations 36, 38 may be formed over the exterior surface of the cutting sleeve 14 by any known method of forming cutting edge configurations on rotary cutting dies. Although only two cutting edge configurations are shown on the sleeve in drawing Figures 1 and 2, it should be understood that in actual use of the cutting sleeve 14 of the present invention a plurality of cutting edge configurations will be formed on the external surface of the sleeve 14 to make the most efficient use of the sleeve surface area available and to cut as many labels from label stock passed through a rotary cutting die press employing the assembly of the present invention.

The bearer rolls 32, 34 are the load carrying surfaces of the cylinders 14. The rolls have cylindrical exterior surfaces that are raised from the exterior surface 28 of the cutting sleeve 14. The diameters of the exterior surfaces of the bearer rolls 32, 34 are equal to or slightly greater than the diameter of the peripheral surface of the cutting edge configurations 36, 38 formed on the exterior surface of the sleeve. The diameter dimensions of the bearer rolls 32, 34 are chosen to maintain the proper spacing of the sleeve 14 center axis and the axis of the anvil roll of a rotary cutting press employing the assembly of the invention. The diameter dimensions of the bearer rolls 32, 34 also maintain a desired distance between the cutting edges 36, 38 of the cutting edge configurations on the sleeve 14 and the surface of the anvil roll of the cutting press with which the assembly of the invention is employed.

The drive gear 16, having a bore 42 at its center and gear teeth 44 formed around its periphery, is slip fit on the right end journal shaft 24 of the mandrel. The gear 16, like the cutting sleeve 14, is removably slip fit on the mandrel 12. The gear is slip fit on the right journal shaft 24 and abuts against the right end of

the mandrel middle section 18 as is best seen in Figure 1. The gear 16 also engages in friction engagement with the right most end of the cutting sleeve 14 as viewed in Figure 1, to provide a positive driving engagement between the gear and the cutting sleeve. Although a friction engagement between the gear and sleeve is shown in Figure 1, it should be understood that other methods of providing a positive mechanical engagement between the driving gear 16 and the cutting sleeve 14 may be employed in lieu of the friction engagement disclosed. The teeth 44 of the driving gear 16 mesh with teeth 46 of a gear on the anvil roll 48 of the cutting press (shown in phantom lines) with which the assembly of the invention is employed. The meshing of the driving gear 16 with the anvil roll gear of the cutting press delivers rotational force to the cylindrical cutting sleeve and maintains a synchronous rotating movement of the cylindrical cutting sleeve 14 with the anvil roll of the press as well as maintaining a registry of the cutting sleeve rotation with other operations performed by the cutting press.

The assembly of the component parts of the invention is basically as shown in Figure 2 of the drawing figures. The cylindrical cutting sleeve 14 is slipped over one end of the mandrel 12 and is slip fit over the middle section 18 of the mandrel. The driving gear 16 is then slipped over one of the two journal shafts 22, 24 projecting from the opposite ends of the mandrel middle section 18 and is slip fit on the journal shaft until it abuts against the end of the mandrel middle section 18 and positively engages the end of the cylindrical cutting sleeve 14 mounted on the mandrel middle section. The assembled rotary cutting die assembly of the present invention is then mounted on a rotary cutting die press in much the same manner as a conventional, one piece, rotary cutting die.

Figure 3 shows an end view in section of the relative positions of the rotary cutting die assembly 10 of the present invention and an anvil roll 48 and pressure assist roll 52 of a rotary die cutting press. The upper pressure assist roll 52 is adjusted to bear downward against the die assembly 10 of the invention, causing it to bear against the lower anvil roll 48 to ensure uniform cutting of the label stock passed between the die assembly 10 of the invention and the lower anvil roll 48. The top pressure assist roll 52 has an undercut middle section 54 and cylindrical bearings 56 at opposite sides of the middle section that bear downward against the bearer rolls 32, 34 of the cutting sleeve 14 and forces the cutting die assembly 10 downward against the lower anvil roll 48. Although a pressure assist roll is shown in Figure 3, it should be understood that the present invention is equally well suited for use with a cutting press employing a load carrying truck or tractor or other force applying means. The bearer rolls 32, 34 also engage in rolling contact with the lower anvil roll 48, and between the upper pressure assist roll 52 and lower anvil roll 48, the cylindrical cutting sleeve 14 is slightly deformed into an almost imperceptible oblong shape as viewed in Figure 3 due to the slight difference in the interior diameter 26 of the sleeve and the exterior diameter of the mandrel middle section 18. The deformation of the sleeve is so slight that the sleeve returns to its circular cross section once the force of the pressure assist roll 52 and anvil roll 48 are removed.

The cutting edge configurations 36, 38 of the cutting sleeve 14 are the critical portions of the die cutting assembly 10 of the invention that wear in use. Accordingly, it is only the cylindrical cutting sleeve 14 that need be replaced when the cutting edges 36, 38 of the sleeve are sufficiently worn, as opposed to replacing the entire rotary cutting die of the prior art. The

savings in material involved in replacing the cutting sleeve of the assembly as opposed to replacing an entire rotary cutting die of the prior art should be readily apparent. The cutting sleeve represents a small percentage of the total weight of the rotary cutting die assembly, and the material costs, heat treatment costs, and shipping costs involved in the manufacture and replacement of the cutting sleeve are significantly less than those involved in replacing an entire rotary cutting die of the prior art.

While the present invention has been described by reference to a specific embodiment, it should be understood that modifications and variations of the invention may be constructed without departing from the scope of the invention defined in the following claims.

What is Claimed is:

1.

A rotary cutting die assembly comprising:

a mandrel having an exterior surface, the mandrel being adapted to be mounted for rotation on a rotary die cutting press;

a cylindrical sleeve having an interior surface and an exterior surface, the sleeve being adapted to be slidably received on the mandrel with at least a portion of the sleeve interior surface engaging at least a portion of the mandrel exterior surface; and

at least one cutting edge formed on the cylindrical sleeve exterior surface.

2.

The die assembly of Claim 1, wherein:

the cylindrical sleeve is removably received on the mandrel enabling the sleeve to slide on the mandrel and slide off the mandrel.

3.

The die assembly of Claim 1, wherein:

the cutting edge is a raised cutting edge.

4.

The die assembly of Claim 1, wherein:

a plurality of raised cutting edges are formed on the cylindrical sleeve exterior surface.

5.

The die assembly of Claim 1, wherein:

the cylindrical sleeve has opposite first and second ends, a bearer roll is formed on one of the first and second ends, the bearer roll being adapted to rotatably bear against an anvil roll of a rotary die cutting press.

6.

The die assembly of Claim 1, wherein:

the cylindrical sleeve has opposite first and second ends, a first bearer roll is formed on the first

sleeve end and a second bearer roll is formed on the second sleeve end, the first and second bearer rolls being adapted to rotatably bear against an anvil roll of a rotary die cutting press.

7.

The die assembly of Claim 1, wherein:

the die assembly includes a drive gear, the drive gear being adapted to be slidably received on the mandrel and to engage with a gear of a rotary die cutting press, and the drive gear being adapted to engage in a driving engagement with the cylindrical sleeve slidably mounted on the mandrel.

8.

The die assembly of Claim 1, wherein:

the mandrel is formed as a cylinder having a constant diameter across the mandrel, the cylindrical sleeve interior surface has a constant diameter across the sleeve, the cylindrical sleeve interior diameter being larger than the mandrel exterior diameter enabling the cylindrical sleeve to deform on the mandrel when pressed between an anvil roll and pressure assist roll of a rotary die cutting press.

9.

The die assembly of Claim 7, wherein:

the cylindrical sleeve and the drive gear are both removably received on the mandrel enabling both the sleeve and the drive gear to slide on the mandrel and slide off the mandrel.

10.

A rotary cutting die assembly comprising:

a mandrel having an exterior surface, the mandrel being adapted to be mounted for rotation on a rotary die cutting press;

a hollow cylindrical sleeve having an interior surface and an exterior surface, at least one cutting edge formed on the cylindrical sleeve exterior surface,

the sleeve being adapted to be slidably received on the mandrel; and

a drive gear adapted to be slidably received on the mandrel and to engage with a gear of a rotary die cutting press.

11.

The die assembly of Claim 10, wherein:

the drive gear is adapted to engage in a driving engagement with the cylindrical sleeve with the drive gear and the cylindrical sleeve slidably received on the mandrel.

12.

The die assembly of Claim 10, wherein:

the cylindrical sleeve and the drive gear are removably received on the mandrel enabling the sleeve and the drive gear to slide on the mandrel and slide off the mandrel.

13.

The die assembly of Claim 10, wherein:

the exterior surface of the mandrel is cylindrical and has a constant diameter across the mandrel, and the interior surface of the sleeve is cylindrical and has a constant diameter across the sleeve.

14.

The die assembly of Claim 13, wherein:

the cylindrical sleeve interior diameter is larger than the mandrel exterior diameter enabling the cylindrical sleeve to deform on the mandrel when pressed between an anvil roll and a pressure assist roll of a rotary die cutting press.

15.

The die assembly of Claim 10, wherein:

the cylindrical sleeve exterior surface has a plurality of cutting edges formed thereon.

16.

The die assembly of Claim 10, wherein:

the cylindrical sleeve has opposite first and second ends, a first bearer roll is formed on the first end of the sleeve and a second bearer roll is formed on the second end of the sleeve, the first and second bearer rolls being adapted to rotatably bear against an anvil roll of a rotary die cutting press.

17.

A method of providing a rotary cutting die with a replaceable cutting edge configuration on the die, the method comprising the steps of:

providing a mandrel having an exterior surface, the mandrel being adapted to be rotatably mounted on a rotary die cutting press;

providing a hollow cylindrical sleeve having an interior surface and an exterior surface, with a cutting edge configuration provided on the exterior surface of the cylindrical sleeve;

providing a drive gear having a center bore and peripheral gear teeth adapted to engage with a gear of a rotary die cutting press;

assembling the cylindrical sleeve to the mandrel by sliding the cylindrical sleeve over the exterior surface of the mandrel; and

assembling the drive gear to the mandrel by sliding the drive gear over the exterior surface of the mandrel.

18.

The method of Claim 17, including:

removably sliding the cylindrical sleeve and drive gear over the exterior surface of the mandrel.

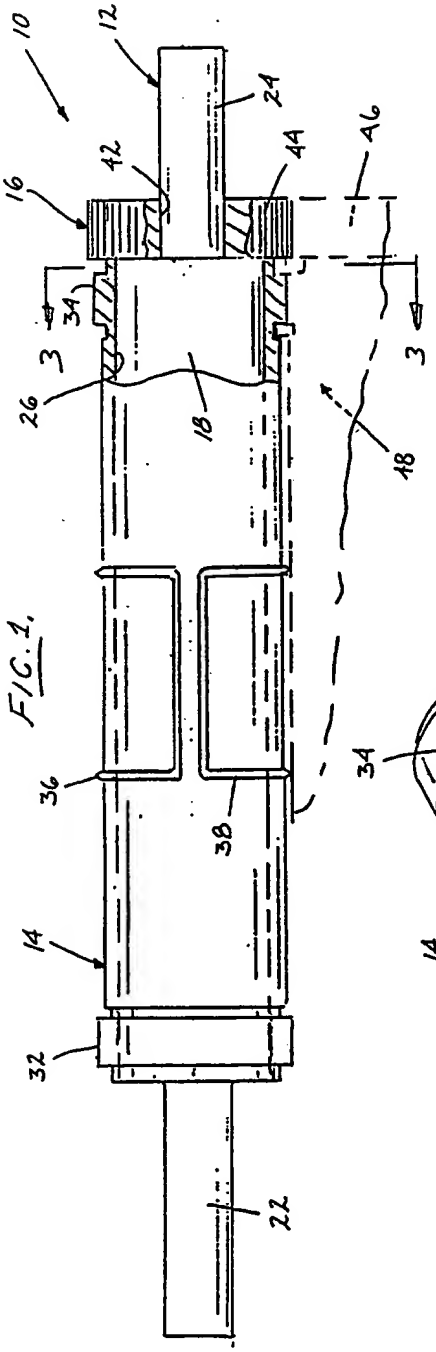


FIG. 1.

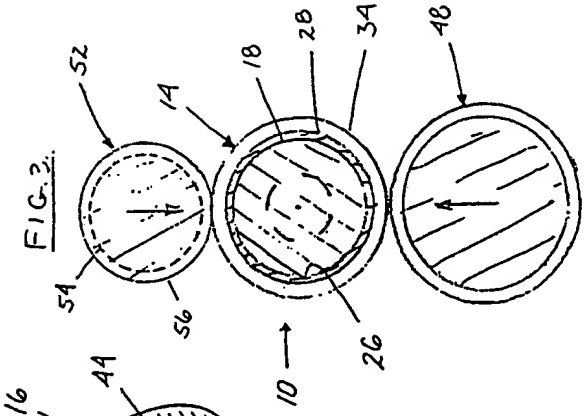


FIG. 3.

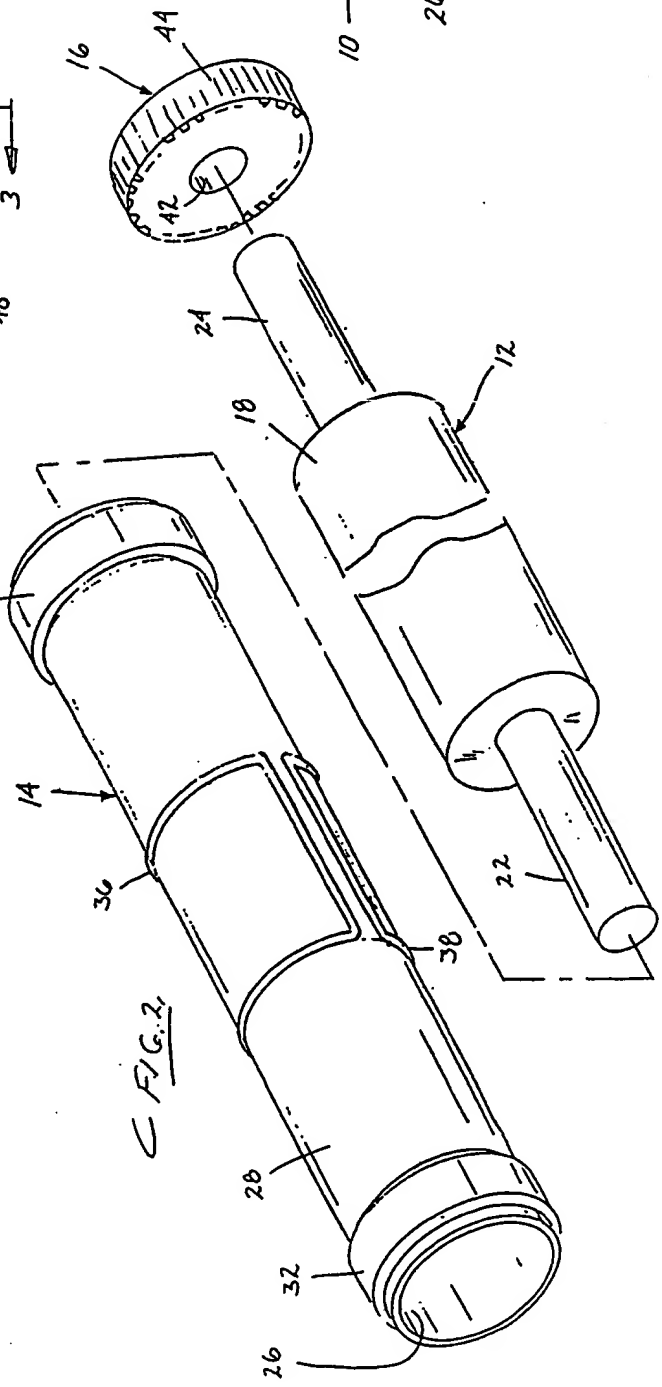


FIG. 2.

I. INTERNATIONAL SEARCH REPORT

International Application No PCT/US91/04297

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC(5); B26D 1/40, 62; B26D 3/08, B31B 1/14,25
US CL ; 83/346,673

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
U.S.	343-346,659,663,673,674,675

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X Y	US, A, 4,770,078 (GAUTIER) 13 SEPTEMBER 1988 See entire document.	1-6,8 7,9,10-18
X Y	US, A, 4,625,612 (OLIVER) 02 DECEMBER 1986 See entire document.	1-4,7,10-12,15, 17,18 9,13,14,16
Y	US, A, 4,993,293 (CHRISTOFFERSON ET AL.) 19 FEBRUARY 1991. Column 4, lines 1-59 and figs. 4A,5 and 8.	7,9,10-18
&	US, A, 3,965,786 (D'LUHY) 29 JUNE 1976	
&	US, A, 4,934,231 (CHESTNUT ET AL.) 19 JUNE 1990	

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
15 OCTOBER 1991	01 NOV 1991
International Searching Authority	**Signature of Authorized Officer**
ISA/US	HIEN H. PHAN

Form PCT/ISA/210 (second sheet) (Rev. 11-87)